

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (30) ADVANCED SEPARATION PROCESSES

Subject Code: 3713013

SEMESTER: I

Type of course: Core

Prerequisite: Mass Transfer fundamentals

Rationale: The aim of this subject is to impart comprehensive understanding to the students regarding various novel and advanced separation techniques and its advancement which have profound significance in Industrial and Research arenas.

Content

Sr. No	Topic	Teaching hours	Module% weightage
1	Multi Component Distillation Selection of operating pressure, Equilibrium for Multi component System, Methods for Multi Component Distillation, Design of Batch Distillation for Multi component with Rectification, with constant reflux and constant over head component, Continuous distillation of multi component system, Energy Conservation in Distillation column, Advanced topics in distillation, Short path distillation	12	22
2	Types and choice of membranes, Plate and frame, tubular, spiral wound and hollow fiber membrane reactors and their relative merits, Commercial, pilot plant and laboratory membranes permeators involving dialysis, reverse osmosis, Nanofiltration, ultrafiltration, Microfiltration, Gas separation by membranes, Membrane Distillationj	10	18
3	Advances in Absorption Criteria for selection of packed tower, tray tower, Spray chamber, Venturi Scrubber etc. Design of Falling Film Absorption, Design of Spray Chamber , Design of Venturi Scrubber, Advantage of Falling Film Absorber	9	17
4	Separation By Adsorption Techniques: Mechanism, Types and choice of adsorbents, Normal adsorption techniques, Affinity chromatography and immuno chromatography. Types of equipment and commercial processes, Recent advances and process economics.	9	16
5	Ionic Separations: Controlling factors, Applications, Types of equipment employed for electrophoresis, Di-electrophoresis, Ion exchange chromatography and electro dialysis, Commercial Processes.	8	14
6	Other Techniques: Separations involving Iyophilisation, Pervaporation and permeation techniques for solids, liquids and gases. Industrial viability and examples, Zone melting, Adductive crystallization, Other separation process, Supercritical fluid extraction, Oil spill Management, Industrial effluent treatment by modern techniques.	7	13

References:

1. Equilibrium-stage separation operation in chemical engineering by Ernest J. Henley and J.D. Seader.
2. Chemical Engineering Handbook 7 th edition by R.H.Perry & Green D.
3. Mass Transfer Operation 3 rd Edition by R.E.Treybal.
4. Industrial Processing with Membranes by Lacey, R.E. and S.Loeb - Wiley -Inter Science, New York, 1972.
5. New Chemical Engineering Separation Techniques by Schoew, H.M. - Interscience Publishers, 1972.
6. Ronald W.Roussel - "Handbook of Separation Process Technology ", John Wiley, New York, 1987.

Course Outcome:

1. To familiarize students with various advanced aspects of separation processes and the selection of separation processes.
2. To enable students to understand the principles and processes of adsorption, membrane separation and chromatography
3. To introduce them to new trends used in the separation technologies.
4. To identify the types of experimental data needed for the calculation of membrane parameters.
5. Apply advanced separation techniques to identify and study environmental as well as chemical industries problems.

List of Experiments:

1. Study of membrane modules and their parts for pressure activated Membrane separation Process such as Reverse Osmosis, Nano Filtration, Ultra Filtration, Micro Filtration
2. Practical on Gas Absorption
3. Practical related to Bubble Cap Distillation Column (Continuous Distillation)
4. Experimental determination of permeate flux, permeate rejection and permeate characteristics in RO, NF, UF and MF membranes.
5. The above experiment should be repeated with different membranes and fluxes may be compared Determination of Membrane Permeability using different membranes.
6. Swelling characteristics of membrane used in separation of aqueous-organic mixture

Major Equipments: Bubble Cap Dist Distillation Column → Gas Absorption apparatus → Membrane modules etc. →

List of Open Source Software/learning website: Students can refer to video lectures available on various websites including NPTEL. → Students can refer to the CDs which are available with some reference books for the solution of → problems using softwares. Students can develop their own programs for the solutions of problems using excel, Chemcad and other simulation softwares.